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Sociology in complexity [1]

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ABSTRACT

The article is a simultaneously didactic and informative deep introduction on the emergence of the paradigm of complexity for sociology. Along the narrative, we make comparisons, which allows the reader who is not familiar with the themes of science to identify the macro-paradigmatic pre-modern differences from simple modernity and the emergence of the paradigm of complexity. Whenever it is possible, we define and exemplify the terms, assertions, and principles that are significant for an understanding of the theme. We have also made numerous indications of authors and works within the narrative, thus those willing might take a deeper dive in the pathways of sociology of complexity.
The article starts with an introduction that defines, after Thomas Kuhn, the concept of paradigm. Then we comparatively develop the most important principles of the paradigm of complexity. And finally, we draw attention for some challenges of sociology in complexity, warning against the risks of paralysis of complexity in the hard task of re-linking knowledges in face of the hyper-specialization present in the crisis of the paradigm of simple modernity.

Key words: paradigm of complexity, sociology and complexity, knowledge of knowledge, modulation of complexity.

> *Natural science will in time incorporate into itself the science of man, just as the science of man will incorporate into itself natural science: there will be one science.* (Karl Marx, Economic-Philosophical Manuscripts).

[1] I am grateful to Maíra Baumgarten for her generous criticism on the text; many of her suggestions have been incorporated into the text; and also for the enlightening debates that we had on the challenges of contemporary science. I also thank José Vicente Tavares for what I have learned from our discussions and activities on the importance of Michel Foucault for the debate on complexity. Certainly, many of the ideas articulated here will not be in complete agreement with, and some will even diverge from those of my colleagues, professors and researchers who have contributed to my formulations.

I - Imagining the world within the world.
Some words on paradigm: new ways to think and shape knowledge

It was Thomas Kuhn who popularized the term paradigm, in his book *The Structure of Scientific Revolutions* (KUHN, 1962). In his work, one can find many notions of paradigm in different scopes and scales. Kuhn's major contribution was to show to the entire scientific community that our concepts, sophisticated as they are, are always opinions, ideas and methods of knowledge verification, shared in a historically determined context, within a certain period. Regarding the different notions on paradigm that Khun lists in his work, there is one that is important here: the idea of a macropattern of world conception, which Edgar Morin articulates as "a conception, a logical relation, extremely strong between the master notions, key notions and key principles"[**] (MORIN, 2003:85). It is this relationship between principles that will dictate all purposes, in unconscious obedience, to the whole empire of knowledge of a certain historical period.

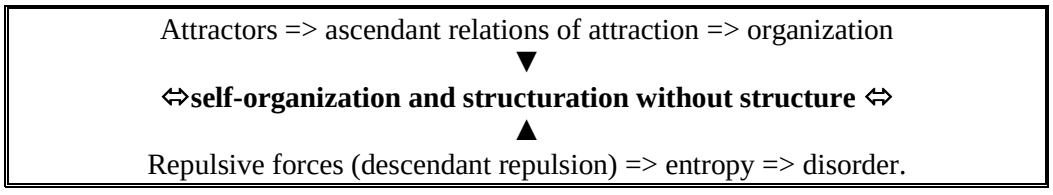
Therefore, paradigm here stands for a macromodel, a pattern of world conception, shared by a particular scientific community, set within a certain historical period.

Newton, for example, consolidated the Cartesian paradigm with his mathematical formulations and underlying theories, mostly, through the great mechanistic synthesis of his law of universal gravitation.

There are basic concepts for the modern Cartesian-Newtonian paradigm, such as: gravitation; the Newtonian force; mind and body as separate entities; the search for the objective truth without interference from the researcher (without subjective evaluation, without intentionality,…) in the representation and construction of the knowledge of reality; the structure divided into divisions and functions; the notion of time arrow and representations or equations without historicity, etc.

Therefore, there is a paradigmatic consensus within the Cartesian-Newtonian paradigm that states that nature has a given order, and that its structure, to be deciphered, has to be split into increasingly simple pieces of objects, and that those can be measured in all their thicknesses, small as they are (the principle of separability within the paradigm of simplicity).

There are other basic concepts to the paradigm of complexity, such as, for example, the concept that makes possible to explain the quantum effects and relativity integrated into the simultaneity of time and space (one instant in time as a set of multiple coexistent events). Demonstrations of nonlinear mathematical models and strong and weak nuclear interactions are applied. The subject is considered inseparable from the object (dependence of the reference system), from the idea of matter integrated to conscience in organized structuration. In complexity, there is no given structure, no given order, but a tension between equilibrium and disequilibrium that involves self-organization and chaos between forces of attraction and repulsion, which can be didactically demonstrated this way:



There is no use from self-organization if it is not considered in the scope of the inseparability, of physical and social self-organization, i.e., that there is something that is organized

outside the authority of our decisions, whose possible deterministic control we can not foresee (BECK, 1998, 1999).

The word *complexus* means "something that is linked, that is woven together". It is this fabric that we need to visualize. The adjective complex (from Latin *plecto*, *plexi*, *complector*, *plexus*: *fabric*, *braid*, *entwined*, but also *covered*, *wrapped*, *apprehended by thought*). In its trivial use, complex becomes synonymous of complicated (*plico*, *are*, *to fold*), something that is wrapped up waiting to be simplified.

The notion of complexity has been improved lately, ever since the importance of the links and the specific properties of the sets were rediscovered and enhanced by new epistemological mobilizations more up to date in relation to the actions of covering, wrapping, containing and apprehending the world, the reality data through a wide-ranging thought organization, by means of articulated and articulating actions, reconnecting the separated elements and data, and also allowing the emergence of heterogeneity, in which the original meanings must retain their own specificities, as intended by Paschal, who affirmed that the parts are inseparable from the whole to the same degree that the whole is inseparable from its parts. (ARDOINO, 2004:548 - 549).

The principle of separation is not dead, but it is insufficient. It is necessary to separate, to distinguish, but it is also necessary to assemble and link it. The principle of order is not dead, it is necessary to integrate it into the order-disorder-organization dialogic. The principles of simplification and reduction are certainly dead, because it is not possible to reach the knowledge of the whole starting from the knowledge of the base elements (MORIN, 2004:564).

The transgression came with the microphysics. The scientific reasoning, based on the agreement between rationality and data obtained through observation and experimentation, started in the first rupture with the paradox of the materiality-immateriality dichotomy, matter that behaves as a corpuscle, as an isolated body, and in other cases presents a continuous and chaotic behavior not unlike that of a wave. The contradiction occurs between these two absolutely conflicting dimensions. There are many who even now try to conceal this paradox, naming the particle *quantum*, but the logical paradoxes reappear in the new domains of quantum physics simplification. This article reiterates the sudden conclusion taught by Nils Bohr, that one can surpass this contradiction only if he assumes the idea of *complementarity* (MORIN, 2004:565).

Quantum physics is one of the most important components of the paradigm of complexity, but the principle of complexity is not confined to quantum physics. Now, we also have the principles of historicity and time, within the macro-paradigmatic principles. In the Cartesian-Newtonian paradigm, on the other hand, there is no historicity in matter, in the "precision" of its formulas and development of calculations.

Today it is known that even inside the matter there is historicity, and that the cosmos itself is in expansion and contraction. The confrontation of time in the paradigm of simple modernity started in an incipient form with Charles Darwin, with his theory on the evolution of life (DENNETT, 1998). Later, Einstein and Prigogine, as it will be seen later in this paper, adopted time as the key-principle integrated into *systems of references or space-time diagrams*[2], where the values themselves are not subjected to the action of forces in the world of physical and biochemical nature.

It is now understood that matter expands, organizes itself, and even that the universe evolves in an ascendant (organization) and descendant time arrow (entropy). Instead of a structure, there is a complex organizational structuration. Thus, there is order and disorder, that is to say,

[2] It is important to have in mind that special relativity is a space-time theory; Einstein, however, does not mention the measurement or observed concurrence of time intervals or spatial magnitudes, etc. This is important, because Einstein's theory does not have to do with measurements or operations that can be performed with rulers and absolute clocks. It is about the physical phenomena's dependence of a reference system, in which special relativity makes the relations of concurrence, duration and spatial interval dependents of the reference system. Thus, there is no absolute space or time, which implies much more complex mathematics, including applied mathematics. See: RUSSEL, Bertrand. *O A B C da Relatividade*. Rio de Janeiro: Zahar Editor, 2005.

productive chaos within order, whose unbalance, favoring order or disorder, can lead to the complexity paralysis (entropy). Absolute equilibrium also leads to complexity paralysis.

There is a blur in the borders between the physical, social and biological world, which Michel Foucault demonstrated decades ago with the emergency of biopower, the dematerialization from the body-power to life-power (TAVARES DOS SANTOS, 1966:7 - 16). These days, people live the empire of dematerialized information. In face of the recent advances in Physics, Biology, Biochemistry, the necessary distinction between the organic (wet) and the inorganic (dry) world is questioned; between living beings and inert matter (life ⇔ matter ⇔ information), between human and non-human. The characteristics that were thought to be specific and complex of human beings and social relations, such as: self-organization, metabolism, self-reproduction are also found in the physical and biochemical world. This brings deep implications to the knowledge about life in society.

Finally, there is one of the most important of the complexity principles, the statement that there is not only one plan of reality. The world, and also our presence in it, is part of multiple simultaneous plans of reality integrated into the new limits of science in the presence of the infinitely great and the infinitely small. This is the big question and the most important structurating principle of complexity.

For a long time, quantum mechanics has questioned and put in check the contemporary philosophical dogma of the existence of only one level of Cartesian reality. Werner Heinsenberg almost got there in his philosophical writings, the concept of "reality level". In his famous "*Manuscript of the year 1942*" (published only in 1989), Heisenberg introduces the idea of three "regions of reality", allowing access to the proper concept of "reality". The three regions he describes are the macro, micro and biological ones. Today, there is also complexity and social complexity, which can cause as much convergence as fragmentation.

It has been demonstrated that the classic sciences have caused a great rupture between observer (individual expert) and reality. This rupture, in terms of science, ruled absolute until the end of the 19th Century, and less absolute until the end of the 20th Century. One of the principles of Descartes affirmed that since there is only one truth about each thing, whoever finds it knows as much about that thing as there is to be known.

The problem of informational complexity integrated into multiple levels of scale will serve as an example. Starting from the smallest possible dimension in current physics, take a measuring device, multiply it by 10 and reduce it to the maximum, the result is: $\rightarrow 10^{-35}$ meters (thirty five negative zeros). According to speculations of theoretical physics, the existence of matter here would not be possible, neither wave nor particle, it would be like the absolute end of matter. Next, consider the other extremity, the maximum possible cosmic scale, and glimpse today what the physicists speculate as the maximum possible size of the Universe: $\rightarrow 10^{26}$ meters (twenty six positive zeros) measured in a distance of millions of light-years (300,000 kilometers per second).

Within the macrophysical and social reality, there is the scale of meters, kilometers, centimeters and millimeters, visible to human eyes. Below, there is the reality of micro-information. It would be like a meter divided into a million equal parts and within the same scale there would be: $\rightarrow 10^{-6}$ meters (six negative zeros). It has been here, in the last fifty years, that the great technological acceleration resultant from digital micro-information and genetic micro-information took place. Computational microelectronics and genetics work only in the micro-scale and, even thus, they currently face complex new dilemmas that disturb them, in face of their implications to the organizational world in human societies.

After the very recent gold rush for digital micro-information and genetic micro-information (Genoma project), which brought the disturbing idea that almost everything that were thought to be small and invisible could be reduced to the microphysics scale of power and the spectre of symbolic

power; now there is a new gold rush, the nano-information[3]. One can now divide the meter into a billion equal parts and, in the same scale there will be: → 10^{-9} meters (nine negative zeros). In the nanometer scale, a strand of hair's diameter is around eighty thousand nanometers, or nano-informations. One carbon nanotube has ten nanos. A DNA molecule is immense in the nano-scale. It has one hundred nanometers and it is a little smaller that a virus. A red blood cell (erythrocytes) is extravagant in the nanometric scale. One cell is in the order of ten microns, or ten thousand nano-informations.

Today, it is known that the truth about a thing is not so simple to find. Each plan of reality has its own specificities. There is a consensus that all manipulation above ten nanometers must be monitored due to possible and probable risks to human life and the environment. However, sociologists and environmentalists are in conflict with the nanotechnologists, who are already creating new products with new reorganized nanoparticles that previously did not exist in the social and environmental macro-reality. Tests are required, but the tests must become a reality in the nano-scale, not in the macro-scale alone, because of the different quantum effects in the different scales of informational reality, such as, for example, the aluminum. In the physical macro-scale, aluminum is harmless, to the point of being used in our mouths, in the form of orthodontic devices. In the nano-scale, on the other hand, aluminum is explosive, as it has been demonstrated by military research.

The nano-information implies immense challenges to an informational nanodemocracy and its effects on the substitutions of materials, energy. It is a recreation of the world, and there will be a deeper and faster impact than that in the scale of micro-information. Digital micro-information needed only fifty years to cause deep impacts in the social and environmental macro-scale. Genetics needed approximately forty years and, judging by the rhythm of the nano-information race (whose technological cycle is just beginning), its macro-social impact must be fulfilled in no more than fifteen years. Our macro-democracy did not even accept the organizational information micro-democracy yet, and it is already facing the organizational nano-democracy. Within informational complexity, then, it must be acknowledged that at the same time there are multiple plans of reality and multiple and differentiated quantum effects as a result of the differentiated and multiple existing plans.

Self-organized patterns emerge from intrinsic instabilities of the system, which is open to basic ingredients such as mass and energy, but not to conduct all information and organization, since it is a self-organized process, and no plan of reality description has ontological precedence over another.

Eventually, there are other less important approaches to paradigms: the microparadigms. These are techniques, procedures or specializations converted into micropatterns, whose qualitative change does not modify or defy the contemporary dominant macroparadigm. This is what happens, for example, when reference is made only to economic subparadigms within the society, agrarian type societies (materiality of the land), industrial societies (materiality of the industrialized merchandises and products), and societies of information (immateriality of ideas, symbols, icons, information-image, aesthetic and knowledge).

[3] The world currently lives a new gold rush, without precedents in history in terms of intensity and speed, lead by big corporations with investments in nanotechnologies. The annual investment in nanotechnologies in 2004, both private and governmental, is esteemed in US$ 8,6 billion. Practically all of the five hundred *Fortune* companies are investing in the research and development of nanotechnological products and processes. In the United States alone, the level of governmental expenses in nanotechnology comes close to US$ 1 billion per year. This value is many times larger than the one destined to the Genoma Project, which makes it the greatest scientific adventure sponsored by public money since the launching of the Apollo mission to the moon (GROUP ETC, 2005:20). The nanotechnology promises to recreate the physical world, implying multiple consequences in the macro-social scale.

Mankind lives in the world of science and knowledge, immersed in a macroparadigmatic transition, rapidly migrating from the Cartesian-Newtonian paradigm to the paradigm of complexity.

The change of paradigms in History is also related to the exercise of power. The transition from one paradigm to another brings forth a new world conception that becomes effective while another is left behind. Consequently, in a period of transition between paradigms, it is particularly important, from the epistemological point of view, to observe what happens to these sciences. Today, for example, it is not enough to call attention to the overcoming of disciplinarity of knowledge and the rupture of the modern distinction between natural and social sciences. It is necessary to know the meaning and content of this distinction and this overcoming, and a new modulation, complex as well, to the proper knowledge and the scientific work. There is talk of transdisciplinarity, in complexity, yet the old paradigm's disciplinary structuration is kept intact in the universities and research centers.

The advent of the paradigm and the epistemology of complexity, by Edgar Morin, challenges mankind to face new possibilities of modulation (procedures), complex as well (MORIN, 2000b). The theory of complexity has advanced more intensely than its modeling. Modeling in a complex way is one of the challenges that the new paradigm proposed by Edgar Morin has brought to the restless scientific minds. In this sense, the complexity is thought to concern, in general, the handling of knowledge in an integration of multiple and simultaneous plans of reality: the macro, the physical, the microphysical and, currently, the nanophysical plan (TOMA, 2004, MARTINS, 2005, GRUPO ETC, 2005).

There are periods of paradigmatic transition with more intense states of turbulence. The new paradigm has different repercussions in the many regions of the dominant and current paradigm, and as a result the future signs become ambiguous.

In phases of transition and scientific revolution, there is much unpredictability, when the epistemological reflection becomes more advanced and sophisticated than the scientific practice. Today, it is impossible to visualize with certainty concrete projects of inquiry that entirely correspond to the emergent paradigm. There are still many operational imbalances when one has to formulate research projects in disciplinary modelizations fragmented by Cartesian methodologies integrated into reductionistic and mechanist logics (problems, hypotheses, operationalization of linked hypotheses within disconnected theories, with low density and complexity in informational methodologies, etc.). Through experimentation, mankind is still getting acquainted with new and more complex operational, informational and procedural modalities, especially when researching new and more emergent phenomena within the contemporary social macro-reality.

As a result, although very present, the paradigm of complexity is still in a stage of paradigmatic transition. Even so, mankind knows it is following what is new, but not exactly where. The epistemological condition of science has consequences in the scientists' existential condition. After all, if all knowledge is self-knowledge, then, all ignorance is self-ignorance (SANTOS, 2001:58).

The ones that insist that there is nothing new to inaugurate a new paradigmatic age are not few. Renowned people and reputable thinkers, such as Habermas, Hobsbawn, and even Einstein - who contributed immensely to knock down the Newtonian mechanist edifice - did not see anything new in paradigmatic terms. Also the positivists, neopositivists, naturalists, or (the more conservative) technologists, even the more experimentalist or rationalistic ones, do not tire to affirm that man is currently living nothing more and nothing less than the radicalization of modernity. Einstein's disturbing theories on relativity still find resistance, even though almost all of them have already been found, demonstrated and experimentally validated. Theoretical physics continues to be the target of many critics from experimentalists, because it discloses deceitful and ambiguous approaches, as it has been recently exposed by the doctor and scientist researcher Ério Brasil Pellanda, in its latest book (PELLANDA, 2005).

A premise of this article is that, in accordance with Khun, a paradigm can have duration, time, a defined history, values and principles accurately acquired and shared. It believes it is possible to identify these values and also how these values can be known and shared within a historical period, to verify ruptures and detect the precise emergence of a new beginning, new ways to model knowledge, to know, to socialize the knowledge, that is to say, knowledge's new place in the macro-social world.

II - A little bit of history: the transition from the astrological paradigm to the modern Cartesian-Newtonian paradigm and the emergence of complexity.

When does a paradigm cease to exist? Which legacy does it leave (continuity)? What breaks it? What are the new options and directions? What is obsolete and left behind, from its narrative, organization, principles?

If the modern term is too broad to have one meaning, imagine, then, the long duration of the premodern paradigm, that here will be referred to as the astrological paradigm. How long can a paradigm last?

For how long the modern paradigm will circulate? For how long mankind will have to coexist with the deconstructive excess of the 'post' prefixes (postmodern, postmodernism, postindustrial, posthuman …) that had been seen since the 1960s, in the previous century? And more: when will knowledge be reconnected with the new and complex symbiotic (from *symbiosis*: to live together) constructions?

Much has been written about the new paradigm of complexity; therefore, due to time and precision, this article will only register some historical and didactic descriptions of the emergence of complexity. For this reason, it goes back in time a little, and looks into where mankind came from, from the paradigmatic point of view, that is, the premodern astrological paradigm, and what is behind the modern paradigmatic rupture.

To achieve its purposes, this article will concentrate on the description of two great basic principles that lead the entire history of the premodern astrological paradigm within the same paradigmatic conception of world, and establish relations, dialogues with the precise ruptures and choices accomplished within the macroparadigm of simple modernity, as opposed to the astrological paradigm. At the same time, whenever it is possible, the article introduces discussions into this comparison, in a transversal way, with the current ruptures and new meanings found in the macroparadigm of complexity.

The two above mentioned basic principles that lead the entire history of the astrological paradigm are examined below:

1) The principle of similitude.

To the premodern ones, knowledge production was like handling a soup cauldron, with different ingredients, with an approach neither fragmentary nor disciplinary, where everything was coming closer, looking for proximity.

The principle of similitude discloses a very specific premodern way to produce and handle knowledge. Michel Foucault had already stated the idea, in the 16th Century, that awareness leaves (behind) the memory of a mixed and unruly knowledge, where all the things in the world could, by chance, come closer to experiences, traditions or beliefs (FOUCAULT, 1987). The premoderns dealt with a system of similitudes that consisted of approximating things to search for everything that could be seen as a kinship. However, this process was deeply transformed due to the modern imposition of thinking.

The modern ones, in contrast, instead of proximity, intended to distinguish things, i.e., to separate them and establish differences, to classify them to later rearrange them in a comprehensive mechanism, a new rationally thought totality, distinguishing art from science; subject from object;

objectivity from subjectivity; nature from culture; emotion from reason; and mind from body. They expect a specialized fragmentation of the knowledge to discipline body, eye, the objectiveness in face of methodical observation, in order to conquer the Cartesian objectivity through simplicity:

> "*These long chains of simple and easy reasonings the geometers use to reach their most difficult demonstrations, led me to imagine that all things that may fall into the knowledge of man are mutually connected in the same way, and that, provided only that we abstain from accepting as true something that is not, and that we always preserve the necessary order to distinguish one from the other, there is nothing so far removed from us as to be beyond our reach, nor so hidden that we cannot discover it,*." (DESCARTES 1989:27 - 28 - our emphases)

Here is the "cockcrow" of modern rationalism. The dawn of a whole new age began, an age called the Modern Age. Cartesian petulance. The modern rupture ruled absolute, in terms of science, until the end of the 19th century, and less absolute until the end of the 20th Century. Descartes' belief ruled as if, by knowing only one truth about each thing, whoever found it would know everything that could be known about it.

At last, man will know the truth about everything. Within complexity, it is known that the truth about a thing is not so simple to find as Descartes' great reductionistic certainty. The Cartesian principle imposed the reduction of complexity, the representation of reason with minuscule 'r' (rationalization), as described by Edgar Morin (MORIN, 2000a: 112). Another question that Descartes proposes with his Method is that one must always simplify:

> "*To commence with the simplest and easiest to know reasonings; and, considering that of all those who have hitherto sought truth within the sciences, the mathematicians alone have been able to find any… to fight together with this new spirit nourished by truth, and to dislike false reasonings*." (*Ibid., id*.)

Classic modern sciences brought forth a brutal rupture between observer (the expert agent) and reality (the object to be known). On the other hand, today it is known that matter expands in self-organization in a non-linear and chaotic way, integrated into two simultaneous realities: order and disorder.

The Cartesian-Newtonian paradigm broke into two great derivations: positivism and rationalism.

Positivism is sometimes called realistic, naturalistic scientificism, and at times it is regarded as a simple transposition of mechanics science to all psychological phenomena that can be recognized as behaviors possible to be decomposed into irreducible parts or even "atoms" of action, being taken for a visual, symmetrical abstraction that thought that science's task was just the production of a photographic knowledge of reality: to observe → to measure → to state a law. Knowledge would emerge through mathematical reasoning (more arithmetical) that would make possible to break with common sense, denying or qualifying it.

Even to Bachelard and Einstein's rationalism, the order in the universe and nature was thought to be organized. Einstein, besides all his intuitions and contributions, did not question the implicit order of the modern world, the nature and the mechanistic conception of the Cosmos. Einstein affirmed that science was only changing its focus, from the visible world to the invisible one. However, Einstein discoveries, particularly those on relativity and his new explanations on time and space, were decisive to help erode the solid edifice of the Cartesian-Newtonian macroparadigm.

It was when Cartesian science *decisively* reached the invisible, non-visible world that new thinkers, such as Niels Bohr, Planck, Poincaré and Werner Heinsenberg, among others, first appeared, with rationalistic strength. Therefore, science thinkers such as: Gaston Bachelard (BACHELARD, 1996) in France, and Karl Popper (POPPER, 1975) in Austria, wanted to identify something that was changing within the production of scientific knowledge, and tried to understand how these men were producing the new science. Rationalism is a more complex manifestation of the modern paradigm, but it also considers nature, the order of the universe taken for organized.

Popper, who was not just a logical positivist, as it has been affirmed, demonstrated that the visual science of induction falsifies its axioms with simplifications. His example of the White Swans is basic in this sense. Popper used to say that an inductivist finds more than two hundred white swans and the more he looks for swans, he only comes across white swans. Hence, he creates the axiom: "all swans are white". This will be true until he finds a black swan that will obliterate and bring down the whole of his truth. Popper insisted that scientific discoveries are provisory, particularly those achieved by inductive inference. His answer to the problem of induction is that, in his point of view, science is no more than a conjectural knowledge. Instead of *induction*, Popper proposes the terms *conjectures*, *probabilities*, and instead of *verification*, *falsifiability* (POPPER, 1975:13 - 40).

It was also confirmed that these new scientists, in most cases, produce knowledge concerning an invisible world. Einstein himself stated that the floor disappeared from beneath our feet. How is it possible to test the knowledge and to make science on a subject that can not be seen? Frequently, within the science of the visible world, knowledge could be validated with logical reasoning alone, with the formulation of hypotheses being more easily produced and tested. Thus came into view another modality of expression of the Cartesian-Newtonian macroparadigm: rationalism.

It is not just about the debate between materialism and idealism, but often, to these new rationalists, the long chains of hypotheses and model patterns were restricted only by the experiments of their pens, which they put to paper. Rationalism took to the extreme the power of logic and the modern rationalization, and its followers invested much more in the capacity to reason than in controlled experimentation.

Nevertheless, rationalism was very important to the new scientists and thinkers of the emergent complexity, such as Einstein, for example. Complexity is mostly identified with the rationalists, but it combines, with more cooperation and often more simultaneity, the induction with reflectivity and deduction, with intuition and abduction also cooperating with the sensory resonances, simultaneously. The reflectibility of the complex way meets and connects with the expert knowledge of applications in the process of awareness.

There is a great possibility of complementarity between the analytical and systemic approaches. The first continues to be necessary to extract from reality the elements that make possible to formulate theories; and the second allows one to get a more comprehensive vision of the systems, making viable the effectiveness of the action. It concerns the complex systemic modeling, what the Greek and Latin rhetoric called *inventio*, as defined by Jean-Louis Le Moigne. It is about detaching and discarding "pureness" from the practices, from the expert techniques of the subsystems, and about being always joined, reflectively, by a constant restlessness in one's actions, to always ask what is being made, what is his own action related to, what is it producing, what is it turning into, about being present, together, in contextualized action (MORIN, 2004:545).

In page after page of his four volumes *Method*, Edgar Morin draws attention to this problematic. It is urgently necessary to find the contextualization procedures and learn how to construct, to mankind, rich representations of what is made, of what is heard in deep sensitive and significant resonances.

Within the science of the invisible, the analysis and inquiry process becomes more complex and meticulous; it demands much descriptive and procedural work. Almost all scientists of the complexity formulated complex theories mixed in new applications and qualitative modalities to

produce complex knowledge. Their search for diverse explanations about new phenomena contributed to deny many of the old common truths of modern science.

Thus, the assertion that the subjectivity constructs the experiment, as demonstrated by Heinsenberg, can be better understood. But the advances are not restricted to another way of thinking the world, the nature, the Cosmos and, on the whole, mankind's new place in this world. After World War II, advances in technological applications accelerated so much that technology and science were more intensely combined within the complexity, especially since the appearance of a conscience of the quantum effects and the multiple plans of reality, at the same time specific and simultaneous, in convergence with the physical and social macro-reality.

The modern paradigm has an essential materialistic dimension, even in the sense and understanding of reason itself. Positivism strengthened the materialistic component of the modern paradigm. Thus, materialism could liberate society from its condition historically attributed to religion or speculative philosophy. There was no lack of hermetic mathematical descriptions of the cosmos in the modern ingredient, volumetry and speed of reduced atoms, as with the smallest possible matter, that wandered through incorporeal emptiness in force and speed.

Complexity implies a new and more complex spirituality, inherited from simple modernity. Weber demonstrated that man has a will to be more than he is, and that the occidental lay modernity created for itself a specific, more operational spirituality from its ambitions (WEBER, 1983). The ruin and crisis in the emancipatory promises of modern reason and its deaf dialogue, instrumenting and colonist of the magical thought, have taken a large number of minds to search for "esoteric escapes" disconnected from complexity, even to the point of risking the complex thinking, in face of the emergence of new fundamentalisms and authoritarian and individualistic beliefs. To experiment a profound and complex satisfaction in social life, one needs to be able to face society in a broader context of meaning and value. In a context that exceeds materialism (or reductionistic consumerism) as related to life's limiting interest in the world.

The questioning of the principle of separability, proposed in Cartesian rule, is one of the essential elements of the paradigm of complexity. The modern edifice is in crisis due to the hyperspecialization of the disconnected knowledge in the social macro-reality, producing informational entropy. This is reminiscent of Eliot, who inquired, roughly: "where is the knowledge that we lose in the information and where is the wisdom that we lose in the informational knowledge?" (MORIN, 2000c: 16).

The social view must have a pluralistic and complex spiritual dimension, that is, to be able to answer questions such as: Why is there a society? What is the meaning of if? (ZOHAR, 2000:30 - 31). In which dimensions of the underlying reality its roots, its Ethical dilemmas (with capital E) are found? Ultimately, it is about spiritual questions. It has to do with the understanding of the deepest sense and the restriction of one's acts (limits), and also with a deep respect to the multiple legitimacy of spiritual manifestations and many beliefs of the planetary civilization, mankind's native Earth.

The shadow of the limits of logical reduction and the intrinsic confrontation of contradiction in its domains have also appeared in the highest mathematical thought, in Gödel's theorem, which states that in a complex formal system containing arithmetic there will always be a proposition that cannot be determined and that, even the non-contradiction of the same system cannot be determined. The paradox is also found in social life in its macrophysical scale. When an individual is observed, the species disappears, becomes an abstraction, but when he is observed within a time context, it is the individual that disappears, fades, and the species remains. The principle of identitary-deductive logic is not absolute anymore, and it is necessary to know how to break it (MORIN, 2004:565).

The paradigm of complexity integrates nature and culture that cannot be set apart anymore (inseparability: technology, man, culture and nature), it is like a self-organizing system with entropy - dispersion, but impossible to separate and isolate as intended by the Cartesianism. There are no isolated variables within complexity. As demonstrated by Wigner in his example: "*the measurement*

of the curvature of space caused by a particle cannot be achieved without creating new fields that are billions of times larger than the field under inquiry." (WIGNER, 1970:7).

The second principle of the astrological paradigm, with which simple modernity abruptly broke, was the postulate of division between the cosmic (celestial) sphere and the terrestrial sphere, manifested in the geocentric conception of the world that was harmonized through Biblical interpretation and reinterpreted by medieval theology, mostly by Tomás de Aquino.

2) The principle of separation between physical and metaphysical world.

Just like there are the Laws of Physics to the terrestrial and physical world, there is the Aristotelian quintessence to the Celestial, Astrological world, the Sky, the Cosmos. That is to say that there are other laws, though not physical, to the extraordinary, the divine, the celestial, a place where the Laws of Physics do not work.

It will soon be demonstrated that Galileo substituted, from experience, the idea of the qualitatively differentiated cosmic space for the homogeneous and abstract space of Euclidean geometry. The central point in the fall of the Aristotelian edifice, initiated by Galileo and consolidated by Isaac Newton, consisted of linking land and sky, i.e., the laws that governed the terrestrial phenomena were the same that governed the celestial phenomena. The Aristotelian **quintessence** believed the "sky" was a perfect, unchanging substance, that is, only on Earth there could be chemical and physical changes such as: water, air and fire.

The first major rupture produced in this conception was through the razor-sharp reasoning of Maquiavel, who made a realistic exposition of human's legitimate right to power. The second began with Copernicus and Giordano Bruno, and was completed by the modern Galileo.

This article, however, agrees with Ortega y Gasset's statement that the new man of science became "modern" when he turned into a new man, experiencing a renaissance (ORTEGA Y GASSET, 1989). According to Ortega y Gasset, man's renaissance comes after Galileo Galilei (1554-1642) and René Descartes (1596-1650).

Thanks to the moderns, man replaced the belief that the Earth was flat with that of a spherical Earth; that of an immovable Earth that was the center of a finite universe, according to Aristotle, to that of an Earth that rotates within an infinite cosmos, of which the Earth is a simple satellite that turns around a peripheral star located in a small solar system, in the end of the tail of the Milky Way, in a modest galaxy.

Simple modernity has turned man into the inhabitant of a world external to the subject, ordered, constant, with causal determinism and, most of all, without time, which has an implicit structure. A world where the exogenous subject observes, describes, deciphers and understands the intrinsic secrets of this mechanic structure, through methodical and objective measurement.

Galileo, between 1600 and 1609, developed the conceptions that led him to the geometrization of the science of motion and, according to him, to create two new sciences: ***1)*** *The Geometric study on the resistance of solid bodies*; and ***2)*** *Notes on Motion*. In 1604, Galileo demonstrated his law of free fall.

One of his more significant contributions to science is not a particular discovery, but the fact that he rehabilitated, with new bases, the experimental method, that had been forgotten since the time of Archimedes. Galileo, in the 16th Century, created modern science and provided the support to the Newtonian proposition that would arise in the following century. "The Galilean" method of experimental verification also permitted to contest all evidence that had not been controlled, laboratorial - the conjecture becomes true if the experiment agrees to it.

The method was so revolutionary that it transformed science into something radically new. Before, it was practically obvious that the Earth was motionless and occupied a privileged place within the Cosmos. Everything that he tried to demonstrate was against that evidence. Therefore, it should be false. However, he was right. It was a new reasoning that he had introduced to the world, allowing the appearance of a new form to obtain the truth.

The primary division of separability, in which all modern science is based, works within the distinction between "initial conditions" and the "laws of nature". The "initial conditions" are a realm of complications, accidents, in which it is necessary to select the relevant conditions of the facts to be observed. And the "laws of nature" are a realm of simplicities and regularities where it is possible to observe and measure with accuracy. These distinctions are not "natural" at all. They are completely arbitrary, as described by Eugene Wigner (WIGNER, 1970:3). However, all modern science is based in them.

Therefore, it is necessary to promote and conduct a new transdisciplinarity, to transit from a paradigm that allows one to distinguish, to separate, to oppose and, consequently, to relatively divide the scientific domains; to another, so that they can communicate, without working the reduction of simplicity. The paradigm of simple modernity is mutilating and insufficient. There is need for a paradigm of complexity that, at the same time, divides and unites, that considers levels of emergence of reality without reducing them to elementary units and common laws (MORIN, 2000a: 128).

III - The current macroparadigmatic crisis

The signs that this model of scientific rationality is passing through a deep crisis are strong in some of its main aspects. Mankind is immersed in a period of scientific revolution that first began with Einstein and the quantum mechanics.

In the current complex society, there are sophisticated machines able to produce and manufacture resonances and to pasteurize senses of desire and subjectivities from outside the mind, such as a television or the screen of a cinema or a computer, and to connect man to an hypercortex[4] able to make him feel desires and emotions, even when these are "symbiotically manufactured" (LIMA, 2005:55 - 64).

Experiments show that the human senses are much more flexible and adaptable than they were thought to be. Man travels through them as if they were machines that modulate and manufacture contemporary subjectivities, as if man was a complex being and lived in complex societies with his mental cortex connected to a contemporary and symbiotic hypercortex.

However, it is important to add that the crisis of the dominant paradigm is the interactive result of a plurality of social and theoretical conditions. What is most contradictory in this question is that the identification of limits, of the "structural" insufficiencies of the modern scientific paradigm is, really, resultant from great advances in knowledge, made possible by same the paradigm. The deepening of modern knowledge permitted to see how fragile are the pillars supporting that same knowledge (SANTOS, 2000:68).

Science in the 20th Century resulted from new ways to see the world, the nature, the Cosmos. The first came from the digitalization of matter and energy, atoms and *quanta*, a digitalization that left only a few lost agitating "waves" in the physical, biological and social world. The second is due to the vital necessity to face determinism, and also from the idea that the results

[4] The metaphor of the hypercortex was created by Roy Ascott to call attention to the importance of the emergent informational and telematic culture, and its new individual and collective deeds in contemporary societies. To Ascott, each knot in the net, each server on the *Net* is also part of myself, when, in the net-extension in interaction with the "knots" of the informational nets, I reconfigure myself as well. Surely the symbiotic cognitive sharing of the digital nets has significance in the current world just like the mechanic sharing of long time memories, shared interactions of logical and cognitive routines. Here the article calls attention to another reference, the sensory one, which is not just cognitive, like that resultant from the mimetic reproduction of reality by informational media, including the analogical ones, such as television, cinema, radio, phones and cellphones, sensors, etc… Mimesis, in this sense, does not represent mere "*imitatio*" (imitation of the reality), as in Plato, but significant individual and social action in symbiosis with the deep sensory extensions, involved in media spaces of sensory amplification, which reconstruct and manufacture realities of the current world. On the metaphor of Hypercortex, see: ASCOTT, 1997:336 – 334.

cannot be foreseen at all, because, given the initial amounts of immense particles and informational and symbolic waves, and even the complex process of self-organization, man finds in the physical and social world a self-organization independent of his own deterministic wishes.

These new ways of seeing the world resulted into a new modality of individual insertion in social life, expressed in a complex structuration of the individual and collective action, not the individual-work/body-income anymore, but the individual-information/knowledge-income, a structuration strictly related in net spaces.

Sociology, when immersed in complexity, is impelled by the new emergent macroparadigm to restructure the society of simple modernity, the old States, the old and polluted cities, the relationship between culture and the modern economic rationality with the ecosystem. New processes of income composition and generation appear, new meanings to the work result from the knowledge, not through job-task routines anymore, as well as the need to free life from the myth of the competitive war of the overwhelming market, to rethink the market to act in favor of a new complex reason, just like Hobbes and all the incipient modern contractualists did when they reorganized the early industrial market and premodern public sphere, to the rational conquests of simple modernity.[5]

The modern State, or its derivative public sphere, is a State-process-rationality-norm-contract mobilized to control the bodies and mechanic functionality of the modern commercial and industrial societies, and it must now split into complex organizational public spheres of the macro, micro and nano democratization of information and knowledge. Where is the information in the modern State-Nation-Rationality-Norm-Contract-Control? Information is only a support, an instruction to the process of rationalization and public control. In complex societies, information is the central nervous system. The procedural-material action under control of the rationalization becomes the decisive support to the public sphere's organizational procedures. Within organizational processualistic, information is merely a modest instruction in a rational process. The State within simple modernity was not planned, nor is it prepared to turn information into a significant and effectively democratic public deed.

It is also necessary to confront the challenges of continuity imposition versus societal rupture, and react in face of the old rules of life sintetization and the ecosystem, to the directives of an already old reductionistic and boring game of the industrial market. Without disdaining the importance of contemporary events such as the one that led to the Fall of the Berlin Wall in the Autumn of 1989, and the dismantling of the Soviet empire in 1991, man cannot continue to act as if nothing, besides that, had happened in the economic, politic, social, cultural, environmental and scientific sphere since the 19th Century.

To face with optimism the current conquests on the informational and knowledge domain, increasingly present in the history of the civilizatory course, it is necessary to reconnect the social fabric in a complex self-environmental-organization . To achieve it, it will be necessary to visualize ethics of complexity that do not exist in classic science, since it is deterministic and professes to know the future. There are patterns that are inevitable and unexpected, so, they will have to be recreated within a new Ethical (with capital E) challenge. Thus, it is expected that, after the conquest of the macro-information and with the current conquests of micro and nano-information,

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[5] This would not be the place to deepen into the new and immense challenges of individual and collective deeds of the social agents to the accomplishment of reinventing life within societies immersed in the complexity of knowledge. What is certain is that the modern institutions and their derived rationalistic deeds are not able to establish a new societal construct where knowledge occupies a new place within the arena of relational webs and the new deeds that more and more depart from the economic-material plan to a symbolic and informational dimension. This symbolic and immaterial dimension, to be complex, must not be restricted by the directives of the encapsulated systemic autopoiesis of the recursive cognitive nets, independent of how significant its accomplishments are. It is about a symbiotic and non-dualistic deed, structurating and not structured of open orquestrations, individual or public, and immersed in a complex emergent self-echo-organization.

one can learn that the multiple plans of reality appear theoretically, spontaneously and experimentally, and that they become effective in the complex simultaneity and also in the macro-plan of physical and social reality.

IV - Final words: Linking knowledge, sociological tradition and the paralysis of complexity

The latest insights of Physics, quantum dynamics, chaos theory, dissipative structures of biochemistry, nanotechnology's theories of the infinitely small, theories of information, sciences of life and mind, all of them, increasingly, converge to a new paradigm: that of complexity.

Fields of informational knowledge are more and more integrated into the new soup in the big cauldron of quantum physics, and they supply an immense fabric taken for a fine mesh, in which sociologists committed to understand the life present in the contemporary world must weave the knots that bind and rebind these insights to new insights related to social and daily concerns with the individual and the society.

The recent advances in Physics, Biology and Biochemistry, as Michel Foucault long ago affirmed to denounce the blur in the old natural, biological and biopower social borders, question the distinction between: 1) The organic (wet) and the inorganic (dry) world; 2) Live beings and inert matter (life ⇔ matter ⇔ information); 3) The human and the non-human.

The characteristics considered to be specific of human beings and the social relations, such as: metabolism self-organization and self-reproduction are now apprehended in the non-human physical world. The quantum complexity introduces into matter concepts of historicity that interface with human concepts of freedom, self-determination and even conscience, which were reserved only for "rational beings" (men and women). However, this linking of knowledge between the social, physical, biological and chemical world is not consensual in Sociology, since there are controversies.

Max Weber was the most radical supporter of the separation between science of the spirit and science of nature. Currently, more modern authors maintain this position, such as Jeffrey Alexander (ALEXANDER, apud GIDDENS & TURNER (orgs.), 1999:23 - 90). Anthony Giddens also supports the specificity of social sciences (GIDDENS, 1978, 1999). However, it is interesting to mention that the Giddens' theoretical perspective of structuration resembles Prigogine's approach on dissipative times and its systematization. The Russian biochemist was awarded the Nobel Prize of 1977 for his work related to the new view on living systems. Prigogine contested the mechanist vision of the living system, insisting on the unit between the living and the non-living system. Just like Giddens, in his own way, did the same with the objectivistic mechanisticism of the systemic bureaucracy and the structuralism.

On the other hand, many authors, some of them implicitly, defend the opposite. The examples are: Michel Foucault and his dialogue with multiple knowledges, particularly Biology, Medicine and Law; Ulrich Beck, who is making possible a renewed renaissance of a sociology in Europe, through his deep dialogue with chaos theory; Zygmunt Bauman, who demonstrated that our modernity is increasingly less solid and more liquid, via his dialogue with quantum physics; Boaventura de Sousa Santos; and the more overtly fierce supporter of complexity, Edgar Morin, who has already produced an extensive bibliography, product of a profitable dialogue with scientists from many fields.

In the current phase of paradigmatic transition, there are visible and strong signs of a process of fusing the styles, of interpenetrations between canons. It is necessary to revisit old canons and verify what is hidden under the optics of new perceptions in emergence.

Thinkers such as Thomas Hobbes, John Stuart Mill and, also, the liberal philosopher John Locke fed on the certainties of modern physical mechanics in search of inspiration and example in their writings on the State and Society. Many were the determinant laws of History. Theories such as that of Darwin's mechanist and reductionistic evolution, and Freud's "scientific" model, which presented the ego as a hydraulic system, came from the same source (ZOHAR, 2000:19 - 39).

Saint-Simon, with his utopian socialism, with a more technocratic profile, created the idea of a new knowledge called social physiology. Augustus Comte (1798-1857) and Vilfredo Pareto obtained open support from mechanical and thermal metaphors to describe the dynamics of society. Nonetheless, it was Comte that dubbed the newly created science (Sociology) "social physics".

Herbert Spencer (1820-1903), as well, dialogued with Physics and, in particular, biological mechanistic (organicism in increasing complexity). Some interpretations of Karl Marx (1818 - 1883), one of the most important originators of social sciences, were influenced by the paradigmatic hegemony of Newtonian physics and its great mechanist synthesis on nature and the Cosmos. Within classic Physics, many Marxists reduce Marx to a decipherer and finder of axioms and basic principles of social life, via the matter and bodies within a great system (capitalism). The universal mechanism of the Newtonian cosmic clock becomes, thus, a theoretical model, from which economy, society and the State are compared to a precise mechanism, subject to the laws and the force of engines that mobilize History.[6]

Émile Durkheim (1858-1917) integrated the emergent modern Sociology in a modest precocious incursion with thermodynamics, biochemistry and electricity, in his view of social theory. His concept of anomie in the organic and critical spheres is noteworthy. The concept of "anomie", which Durkheim used in his work *Suicide* (written and published in 1887), points to a social state with neither rules nor laws (DURKHEIM, 2000). The limitless expansion of man's necessities, according to Durkheim, may lead to anomie. Durkheim shows panic in the face of chaos. To him, the anomie happens often as a result of economic depression or prosperity, bringing together a "high degree of digression" from human behavior.

Until now, the social sciences have handled the chaos theory, although peripherally, notwithstanding Durkheim's incipient indications on the problem of anomie. Even today, the social sciences are limited to the research on structures of order in society and the search for the principles that bring forth this order. The concepts of revolution and crisis reveal the chaos, but they still have an apparent negative formulation.

To Durkheim, especially in his functionalist phase, the increasing division of the social work brings the need to form a web of rules to recreate solidarity between the divided functions. Thus, any new formation of agencies and social functions causes anomie if, at the same time, it is not stopped by cooperation rules (DURKHEIM, 1999).

Durkheim, as already mentioned, sees the problematic of chaos, even though he does not give it a deeper treatment. He only shows the spontaneous formation of rules in anomic processes (chaos) as a state of disturbed order and not as an effective complex productivity of self-organization (DURKHEIM, 1982).

Further on, less functionalist and in dialogue with the electromagnetic physics of electrons, Durkheim has another perspective in his incipient sociology of knowledge. It is about a chapter on his book *The Elementary Forms of the Religious Life*, when Durkheim is dealing with collective parties and compares them with a revolution of electrons, to demonstrate his explanation on happy synergy (based on concentration and dispersion), which is a central idea to the paradigm of

[6] This is only one of the possible results from the multiple politic, philosophical, economic and social formulations present in Marx. Unfortunately, the idea of Marx limited to the creator of a "capitalist" system within the molds of a mechanist totality, even if it is in dialectic evolution, has become almost a sociological common sense. However, the Marxist bibliography presents many other dimensions and possibilities, particularly those related to the society/nature relationship and his perspective of History as something do come, uncertain, as indicated by Maíra Baumgarten. For further information, see: BAUMGARTEN, M. Natureza, Trabalho e Tecnociência. In: *Dicionário Crítico sobre Trabalho e Tecnologia*. CATTANI, Antonio David (org.). Petrópolis: Rio de Janeiro, 2002:203 - 213. In addition, it is very important to consider that Marx's bibliography is immense and complex and, most of all, that his work was not produced within the academic and scientific world, but in a deep "praxis" of strategic debate on philosophical, politic, social and economic positions, but with no concerns regarding more specifically dialogue with the directives of modern science.

complexity (DURKHEIM, 2001). The principle of self-organization or self-regulation, as a principle of spontaneous formation of rules - formation of patterns - was clearly known to Durkheim, especially in his theoretical production after 1907.

Émile Durkheim, in his own way, and a long time ago, taught how to think the social relations to the resemblance of the physical phenomena, and in a very generic way he defined society as "collective patterns of thought, feeling and action" (ZOHAR, 2000:21). This definition is so generic that it involves atoms, molecules, neurons, bodies, minds, planets, etc…

Nevertheless, the incipient functionalistic concept of anomie or the crises of synergy waste are, to Durkheim, always dependent on the pre-eminence of organization over dispersion and inhibit a deeper comprehension of the capacity of individual or collective deeds inserted in the processes involved by self-organization. Today, unlike Durkheim, man is already convinced that the world does not have an implicit structure anymore (closed systemic totality).[7]

Of the classic originators of social science, Max Weber was the one that more openly distrusted the mechanist track of the old physics of nature. Weber defended the necessity to discover a method to allow the establishment of more adequate references to the phenomena of the human activities than what the experimental method allowed to conduct in relation to the phenomena of nature (FERNANDES, 1980:94 - 95).

Thus, Weber created a typical, ideal methodology (to shape subjectivity and objectivity in connection with the senses for the comprehension), innovative at the time, starting from the acceptance that there is no objective neutrality in a process of inquiry within the social sciences. This implied a new modality of accomplishment of "objectivity", the one that does not rest in the object alone, but in investigating the "peculiarity" of that type of knowledge, through which it is known and conducted the ultimate investigative act (WEBER, 1991:87). Weber also defended his non-deterministic and anti-mechanist, neo-Kantian hypothesis that one could never cover and conquer the totality through knowledge.

Curiously, all this effort from Weber is currently related to quantum physics, which defends, to the world of physical reality too, that was is real is not limited to the sum of the parts it has been divided into for observation and measurement. Theoretical physics, which opposes the simplification of the subject/object distinction as well, assumes new shapes and depth of symbiotic form from a *continuum* just like Weber proposed, when confronted with the idea of a complex modelization that contains objectivity, but that also contemplates the subjectivity and that, in a complex way, defends the existence of a structural interference from the observer of the observed reality.

Certainly, Max Weber was not just a sociologist; he had a wide academic formation, concentrated into the study of Law and deep incursions into History, Economy, Philosophy and even Theology. With his death in 1926, Mariane Weber, his wife, who was a feminist and dedicated to the intellectual work too, published an extensive biography of the author, and this biography was, for a very long time, the only source of consultation in this area, intensely influencing the teaching of his work. This way, friends and disciples, such as Karl Jaspers, inspired by the biography Mariane Weber had published, spread out one of Weber's interpretations, which, full of half truths and significant omissions, strengthened the tendency to divulge an excessive formalization in the teaching of Weber, emphasizing his typology more than was necessary (FLEISCHMANN, 1977:139).

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[7] Totality here is understood as a mechanist modelization. Even a dialectic and contradictory totality merely discloses the possibility of a more dynamic and less deterministic modelization of mechanicism in face of the analytical version of totality. Obviously, patterns can be established in a more or less stable way, but within a modelization of possible universality(ies) without totality. It is important to make clear that totality here is not an epistemological category, but a methodological one.

[8] It is to this moment of Weber's production that this article makes most of its references. On the relation and influences of Nietzsche in Weber, see: FLEISCHMANN, Eugène. Weber e Nietzsche. In: *Sociologia:* Para ler os clássicos. COHN, Gabriel, Rio de Janeiro: Livros Técnicos e científicos, 1977:136 – 185.

Weber is the author of an extensive and complex bibliography, full of unrelated influences. He dialogued first with Marx, and later with Nietzsche, two disdained heretics within the walls of German Academy. It was probably Marx who had the most lasting and deep influence on Weber. Most of Weber's works, especially the one known as "The Protestant Ethic and the Spirit of Capitalism" (WEBER, 1983), was conceived with the intention of verifying the justice of the Marxist theory in face of the problematic question of the relationship between infrastructure and superstructure. Perhaps this is the reason why Weber is not widely known by his influences and debates with Nietzsche. [8]

These are some generic examples, which serve only to demonstrate the importance and significance of a critical re-examination of the theoretical, experimental and reflective accumulation of the sociology of simple modernity (classic), and to avoid discarding it or transforming it into fundamentalist or scholastic tradition.

On the contrary, it is necessary to respect and revisit our "classic" tradition, from the point of view of the complexity, to discover hidden connections, questions still unanswered and contributions not yet acknowledged in this recent modern course of the sociological knowledge.

An important question that cannot be forgotten within the complexity is that not all dialogue means a complex linking of knowledges, and greater complexity can also, even with good academic audience or publishing, develop into a form of complexity paralysis.

The idea of complexity paralysis is frequently alluded to in academic debates concerning the complexity. One can quickly affirm that this idea means the adoption, by a determined author, of terms and concepts of complexity, without effectively adhering, in his theory and modelization, with much consequence and depth, to all the implications of the paradigm of complexity, adopting, thus, a complexity that, as a result, becomes paralyzed. Different examples, depending on the situations and circumstances that involve the debate, can be identified. Some of them are listed bellow.

The first example will be Chris Langton's "complex" proposal of artificial life. Langton believes that the informatics' revolutions, even in the biological level, bring back the importance of informational complexity. Chris Langton, with his proposal of bioinformatics and his idea of "Artificial Life", that has many qualities in the technological plan, that divulges and promotes simplifying pretensions that induce the comprehension of the immense complexity that is essential to this side of his new biology's ambitions (LAGNTON, 1989, 1995).

Langton states the certainty that there is nothing in the living beings that cannot be comfortably recreated in the computer. He forgets that there are some traces of intelligence and human life already known to be difficult to define in terms of computability, as some specialists in artificial intelligence already suspected. [9]

In fact, even in the context of artificial intelligence and neural nets, the work of the scientist, more and more resembles, considerably, that of the complex and intuitive artist, since it is necessary, at least, to intuit the simple rules that will produce complex patterns. However, his proposal of artificial life is an immense paralyzing reductionism of vital complexity. The understanding of life is still immersed in many mysteries, but everything that is already known about vital energy departs in complexity from the cybernetic automatism and the recursive cognitivism of logical programs. Even if one knows that these possess a great component of self-organization, its limitation of the vital complexity turns them into mere primary cognitive toys.

Another well-known example of complexity paralysis is the work of Wolfram, which is emblematic in this sense as well. In synthesis, he believes that the Universe as a whole is nothing

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[9] For a more direct and critical discussion on informational reductionism, see: LIMA, Gilson. A Síndrome de Frankenstein: mitos e magias da moderna informação numérica. In: *Revista de Educação, Ciência e Cultura*, Centro Universitário La Salle: Canoas, 1999:79 - 86.

more than a cellular autonomous (WOLFRAM, 1994). Consequently, if this is "true", mankind should abandon everything to learn only the digital language.

The complexity paralysis is also revealed in attempts to migrate and to link concepts of the physical, biological and biochemical world in a simplifying, mechanical way, often without considering the complexity and specificity of the dialogue and the linking of knowledges. Niklas Luhmann's cybernetic society is exemplifying. Despite the great contributions of the social theory, Luhmann exaggerates, possessed by a systemic neopositivism that had already been denounced by Habermas in the visible predominance of the binary totalizing process.

The predominance of the current digital systems is significant, but Luhmann's exaggeration, when he uses the concept of the theory of operationally closed autopoietic systems, even if "functionally" differentiated, underestimates the complexity existing within social dynamics, even in communities with a life simpler than that of the human complexity.

Even a modest species of life, being a complex organization, is capable of faithful self-reproduction. The word "faithful" can have many meanings. A species that reproduces itself with extreme faithfulness (that is, with little Darwinian variability) will not survive even to a small change in the environment. The living beings are, thus, complex, self-sufficient entities, able to sustain themselves only with substances collected from the environment. Surely, this is not applied to the viruses, which are not able to reproduce themselves, as living beings, without the help of other intact cells.

The complexity of human life is immense, and its accomplishment in societies increasingly complex is inserted into multiple open dimensions that always point to the manifestations of the new and the unfinished present in indeterminable results accomplished through self-organization. Cybernetic systems taken by recursive cognitive logic are complex, but they express, as Luhmann himself indicates, a reduction of complexity, and are in fact reducers of the vital complexity and not complexity itself.

Luhmann paralyzes the complexity too, first because he remains limited to the cognitive dimension of the systems derived from cybernetic machines, and also because he keeps the duality of the simple modernity, divided between the vital reality and the reality recreated by systemic reducers, and, even if these cybernetic systems are taken by recursive logic, his social theory is detached and disconnected from reality, in which the complex symbiosis of the social agents' deeds can be significantly accomplished only in reductions determined by the possibilities of the "encapsulating of autopoietic systems".

Within the biophysical world, the universalization is not so "systemically totalizing", it is in movement too, and it is - if it is understood as system - a fluxing system, as Prigogine demonstrated when he integrated a "historical" dimension into Physics and Chemistry starting from his theory of dissipative structures, because during some phases the system's elements behave in a deterministic way, while in others, close to the bifurcations[10], they do it in a non-deterministic way.

To avoid paralyzing the complexity, one must include the sensory, playful, artistic, and intuitive dimensions of the social act, not only the cognitive one, removing the extremities (the extremities are equivalent to death, extinction, complete chaos, or complete balance), the same as in thermodynamics, with its chaotic systems always asking: if there is complexity, is there self-organization too?

Another case, very representative of the complexity paralysis within humanities, often allude to, is that of the well-known mistaken use, mostly of theoretical physics' concepts, by some celebrities, illustrious and renowned postmodern thinkers with their "intellectual impostures", such as Gilles Deleuze and Félix Guatarri, denounced by fierce critics Alan Sokal and Jean Bricmont (SOCKAL & BRICMONT, 1999). The paralysis of complexity, in this case (even without agreeing with conservative physicists Alan Sokal and Jean Bricmont in this discussion, mostly in relation to

[10] A bifurcation is a "point of decision" between many alternatives of development within a system. Crossed this point, there is no possibility of return. The system loses the "memory" of its previous state.

their more or less implicit support of the "disciplinary" division of the physical universe in face of the universe of humanities), consists of the reductionistic diffusion of the possible mechanist transference of physical theories, quantum physics for example, to the macrosocial plan, with much disregard for the specificities and indeterminations related to the macrosocial plan and even the different implications in the plans of reality in face of the quantum effects.[11]

In the same direction, the physicist Zohar Danah states that it is not pedagogical for the complexity to simplify the idea of the observer's structural interference in the observed object, as it has been found in a number of successful books that make the relation between quantum physics and social macro-reality, in which authors encourage their readers to take simplifying conclusions. The implications of this dialogue are complex. Fritjof Capra, for example, elaborates moral and social implications that the mind of the observer creates properties that the electron has, but such properties cannot be, by no means, called objective. There is nothing in the theory of quantum physics to suggest that the observation or the observer *creates* the proper reality: the encapsulating of the wave function of a table cannot turn it into a cat or a kangaroo, especially in a so simplifying way, within the macrophysical plan. It can only become a table (ZOHAR, 1990:52 - 53).

Within education and organizational sciences there can also be found fluctuant "waves of complexity" that reveal the temptation of complexity paralysis, and that can lead to simplistic, non-symbiotic, idealistic or neo-mechanistic ways, if not, being taken for a disconnected esoterism.

There is no claim, within the complexity, of an absolute unification between the social, physical, biological and "natural" world, in a reductionistic way, as intended by classic positivism. However, the physical and social macro-world is regulated by conditions of criticity, instability and sudden and radical changes where the transitions are strictly inevitable and unexpected. These changes are not produced by external agents; they are processes of a self-organization. There is not only one thinking subject, intervening in an object reality; it is an internal self-organizing process. The evolution through discontinuous pattern changes occurs spontaneously, beyond the predictability of the "rational" subject.

Still, with the debates on the emergence of the paradigm of complexity, Sociology has been invited to take a significant role in deciphering the complex knowledge and to propose new social, politic and cultural answer to knowledge's new conquests. Therefore, Sociology must dive deep within border knowledge, in a new transdisciplinarity of reconnection of the knowledges that dialogue deeply and critically with science and technology, expressing new answers to old questions and more emergent social phenomena. Answers inserted within the critical dimension of sociological knowledge and complex answers to the complex challenges of the contemporary societal perspective.

When this article refers to a new transdisciplinarity to reconnect the disconnected knowledge through the disciplinarity of simple modernity, it shares with Jacques Ardoino the idea that it is not related to a reconnection performed within the functionality of the phenomena and situations' multidimensionality, which are frequently associated to the complex thought, but to a multi-referred perspective. The multidimensionality, even if the "dimensions", in a given moment, are attributed to an object, by imposition of an analysis system, keep firmly the trend to a homogeneity, while - in a multi-referred comprehension - with the recognized irreducibility of the optics between themselves, it is about taking into account and always illuminate the heterogeneity (ARDOINO, 2004:554).

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[11] This article agrees with William Everdell, who is not postmodern, when he affirmed, in its extensive research on the origins of the emergent modernist thought of the 20th Century, that most of the postmodern works reflect many difficulties. The authors are taken by something of an affectation, with exclusive eruditions that reflect considerable appearances of cultured exhibitionisms and pedantism, but that only express a potential tendency of a still recent modernism, that tastes, and enjoys, esoteric hints and self-conscious obsessions, sometimes in half satirical and half participant narratives (EVERDELL, 2000:15)

A reconnection of knowledge in a multi-referred way is always taken by a plurality of views, as much competing as casually kept together by a set of joints. Not just directed to its differentiated functional integration between the disciplines.[12]

Whoever intends to tread the way of complexity within Sociology is also defied to propose new organizational modulations of knowledge and informational institutions, new ways of income access, within the increasingly central way of knowledge production, denouncing and formulating alternatives to social exclusion and the degeneration of the societal fabric, denouncing the mercantile reductionistic restriction of the technoscience, the knowledge-product-patent and knowledge originated from limited interests of the technician-power and his beliefs in the technological determinism. This is not a course for someone looking for tranquillity, especially if he lives in a world where scientific and academic careers are still dominated by a scientific knowledge institutionally involved in the webs of the old paradigm of simple modernity.

The Complex Theory of the Society of Information and Knowledge comprehends the simultaneous and multi-referred reality, composed of visible and invisible physical dimensions that must be confronted with deep dialogue with the multiple knowledges, permitting to distinguish, without separating, matter from the spirit; mind from body; nature from life; the individual from the society.

The Sociology immersed within the complexity of knowledge needs to dialogue with the sciences, contributing to increase the reconnecting spaces to the disconnected knowledges, facing complex problematics with new emergent modelizations, in face of the classic individual / society opposition, for the reclassification of the work within knowledge societies, for the new role of the schools, for the relationships between the production of scientific and technological knowledge with the State, the Universities, companies, market and society in general (BAUMGARTEN, 2001:14).

The complex societies have need of science and technology, but inserted in a complexity of reconnected knowledge involved into a structurating and diffusing web of global and multiple civilizatory conscience woven in our ecosystem.

The metaphors and analogies between social and non-social sciences always existed and, more and more, they must communicate and exchange between themselves in a permanent zigzag between both the specific and precise borders. However, a complex dialogue does not accept mechanist fusions, technological determinisms and neither the dream of technoscience - anticipated by some - that fuses technology and science in a simplifying and very non-symbiotic way. A complex dialogue respects the differences, the distinctions, but it comprises immense and deep partnerships.

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[12] Edgar Morin stated that: “science would never have been science, if it had not been transdisciplinary” (MORIN, 2000a: 136-137). The question is not just to make one knowledge transdisciplinary, but which transdisciplinary knowledge is necessary to make. Science is also a knowledge-power, and its disciplinary institutionalization still maintains a high reserve of power.

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